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THE OREGON GROUND SQUIRREL IN NORTHEASTERN CALIFORNIA; ITS ADAPTATION TO A CHANGING AGRICULTURAL ENVIRONMENT

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ABSTRACT: As early as 1918, populations of the Oregon ground squirrel [*Citellus oregonus* (Merriam)] were reported to be increasing in northeastern California, presumably because of "the extensive clearing of the sagebrush and seeding of these clearings to grain and hay."

Populations of this locally important field rodent have continued to increase since that time with the further development of agriculture. Observations of the author during the past quarter of a century indicate that ground squirrels in the most intensively farmed areas are changing their habits; and may be evolving into an ecotype markedly dissimilar to that which existed in the pristine environment.

The range of the Oregon ground squirrel, *Citellus oregonus* (Merriam), extends over almost fifty thousand square miles in eastern Oregon, northeastern California and northwestern Nevada. This region is characterized by its vast expanses of sagebrush and by a harsh, continental climate. Because of its relative recent occupancy and slow development, it is one which affords a good opportunity for observing the effects of environmental changes upon the native species. I have had the privilege of living and working in this region for the past twenty-four years, and of witnessing the effects of such changes upon the populations and the habits of the one native species which is the subject of this paper.

The earliest study of the Oregon ground squirrel was published by Grinnell and Dixon in 1918. Even at that time, some fifty years after the region was first settled, ground squirrel populations were reported to have been influenced greatly by agriculture. So we must depend upon anthropological literature for information concerning the condition of pristine populations.

The Northern Paiute and Achomawi or Pit River Indians, who inhabited the southwestern portion of the Oregon ground squirrels range, commonly used this rodent as a staple item of food, indicating that substantial populations existed within the territories of these two tribes long before the coming of the white man.

But the Modoc tribe, which inhabited the volcanic tableland of central Modoc County and adjacent portions of Oregon, did not use ground squirrels for food. Yet, all three tribes lived in close proximity, and while they were not exactly friendly with each other they did share many common cultural practices, especially insofar as food habits were concerned. The only logical reason for this inconsistency is that the Modoc tribal territory was undoubtedly incapable of supporting large enough populations of the rodent to enable its use as food.

Much of the old tribal territory of the Modocs still remains in a relatively wild state, without populations of the Oregon ground squirrel. But within this territory are scattered parcels of land where farming is practiced, meadows are irrigated or ranges have been seeded to domestic grasses. Ground squirrels have established economically important populations only in such parcels.

To appreciate the reasons for and the significance of such facts, they must be related to the life history of the rodent. Of paramount importance is the fact the Oregon ground squirrel remains in aestivation and hibernation for a period of from six to seven months each year. At elevations between 4,000 and 5,000 feet, where the largest populations occur, the squirrels start going into aestivation early in July, and do not emerge from hibernation until late February or March of the following year.

It is easy to understand why an animal would prefer to remain in hibernation during the long, cold winter; but why should it be necessary for ground squirrels to be in aestivation during the summer and fall, which are the best seasons of the year? The reason for aestivation is that the native vegetation over the range of the species dries up in late June, and the squirrels cannot exist for long without the moisture provided by green plants. Like some other rodent species, the Oregon ground squirrel rarely if ever actually drinks water, but depends upon green vegetation for its moisture requirements.

While this remarkable adaptive mechanism of a prolonged aestivation-hibernation period enables the species to live in an environment which would otherwise be unsuitable, it may not be as efficient an adaptation as one might at first suppose. During the short period of hardly 200 days during which the squirrels are active above ground, they must get into condition to breed, go through a 21-day gestation period and raise and wean a new generation. The new generation is born in mid-April and the young appear above ground about the first of May. From then until early July, little more than sixty days, the young squirrels must grow to adult size and store up enough body fat to sustain them during their long period of dormancy. To do this, green vegetation must be available throughout the month of June.

Before the advent of agriculture, there could not have been many habitats within the range of the Oregon ground squirrel in which the vegetation consistently remained green throughout the month of June. The earliest records indicate that ground squirrel populations were originally confined to such habitats as streambanks and the perimeters of natural meadows, places where succulent vegetation would persist long after the surrounding areas had dried up. Even so, the periodic occurrence of periods of drought, persisting from two to four years, must have had a devastating effect upon ground squirrel populations, and this could well have been the major population regulating mechanism of the pristine environment.

But all of this was drastically changed by the advent of agriculture. Farming created an ideal habitat for the Oregon ground squirrel in places where it had been hardpressed to exist before, and the first crop to do this was grain.

Throughout its range, the Oregon ground squirrel typically invades grain fields in June, when the grain is still green but when the native vegetation is rapidly drying up. While the green leaves and the soft, immature heads of the grain are eaten, the most striking damage is done by the cutting of the grain stalks, which are neatly cut up into two or three inch lengths and left scattered on the ground. The reason for this seemingly wanton destruction is that the otherwise unpalatable stalks provide a readily available source of moisture at a time when moisture is in short supply.

Dryland grain was still an important crop when I first arrived in Modoc County in 1947, and ground squirrel depredation to the grain crop was a major pest problem. But, at that same time, a new forage crop had recently been introduced which was to have a profound effect upon the environment of the entire region.

During the following two decades, the drought-resistant and nutritious Asiatic wheat-grasses were to prove as great an asset to the ground squirrels as they did to the livestock industry. Wheatgrass pasture displaced dryland grain, and thousands of additional acres of marginal land were cleared of sagebrush and seeded to these hardy grasses. Practically all such plantings eventually became infested with ground squirrels.

The enormous increase in ground squirrel populations which took place between 1950 and 1970, largely as the result of wheatgrass plantings, was accompanied by another problem, bait shyness. This was not exactly a new problem in Modoc County, but it was one which we did not expect to appear so suddenly over so large an area.

For years, bait shyness had been a problem only in the Surprise Valley of Modoc County. Unlike the remainder of the county, alfalfa had been a major crop in this valley since pioneer times, and ground squirrel populations there were harder to control and larger than anywhere else. Surprise Valley ranchers had long been forced to use green dandelion baits or carbon bisulphide for control, since the acceptance of grain baits was so poor. On the other hand, bait shy or poison wise populations had rarely been encountered in other parts of the county, and grain baits were used year after year, generally with good results.

The acceptance of grain gradually became so poor in practically all parts of the county that the use of grain baits had to be virtually abandoned. We switched to green baits of either cabbage or lettuce, and about eight years ago started to grow dandelion for use as bait.

Dandelion had been used as a bait material in the Surprise Valley for well over half a century, limited only by the difficulty of obtaining an adequate supply from wild sources. The long-standing use of this material indicates that bait acceptance had been a problem of equally long standing in the Valley.

In the past eight years, we have used large quantities of green dandelion bait, generally with excellent results. But recently we have run into some acceptance problems even with it in the Surprise Valley. This was bound to happen sooner or later for most of the dryland in this valley is planted to wheatgrass and there is an extensive acreage of sprinkler-irrigated alfalfa. Nowhere else in the county are food conditions as good for ground squirrels.

The common consensus of opinion is that bait shyness is the result of a continued injudicious use of poisoned bait, but this phenomenon may be much more complex than just that. On a number of occasions, we have experienced a high degree of bait shyness in fields which had not been poisoned for years. On the other hand, we have never experienced bait shyness in areas or at times when food was in short supply, regardless of the past history of the fields involved. All of this seems logical, for hungry animals of any species are not apt to be so discriminating about the food they eat as well fed ones.

In addition to the development of an increasingly bait shy population, the changing environment has had some other noticeable effects upon the ground squirrels. In the agricultural areas of the county, the ground squirrels now go into aestivation much fatter than they did twenty years ago, and you rarely see any thin squirrels emerging from hibernation as was once common. In the sprinkler-irrigated alfalfa fields, the squirrels are now going into aestivation from two to three weeks later than they used to. Twenty years ago, it was very unusual to see a squirrel above ground after the first of August, now it is not too uncommon to see some active well after that date. But other, less obvious changes may be the most significant.

We see many more juvenile squirrels above ground in May than ever before, and populations now recover from control operations so rapidly that annual control, especially in alfalfa fields, has become a necessity. It has been theorized that juvenile mortality is the direct causal factor which precludes field rodents from attaining the full potential of their reproductive capacity, and this could well be true of the Oregon ground squirrel in its natural environment. But in the present agricultural environment, where food and moisture is virtually unlimited in both quantity and quality, the juvenile survival rate has certainly been enhanced greatly.

Another subtle change has been in the mobility of populations. Oregon ground squirrels have always moved around seasonally to some extent. Such population movements were formerly quite limited in range, but they now have taken on a somewhat different character and extend over a much wider territory.

Alfalfa and wheatgrass starts to grow in early May, and from then until the squirrels go into aestivation these crops are capable of accommodating very dense populations, often numbering up to several hundred per acre. Since alfalfa and wheatgrass fields are generally well drained, the squirrels continue to occupy them during aestivation and hibernation. But the vegetation growth of alfalfa and wheatgrass in late winter and early spring, when the squirrels emerge from hibernation, is insufficient to supply a dense population. Part of this population therefore, disperses into the surrounding wildlands or uncultivated areas, where they remain to have their young. When these areas dry up in June, the squirrels and their subadult young return en masse to the alfalfa and wheatgrass. Field tests have indicated that the range of such movements can be well over a mile; and they are the source of amazement even to some experienced ranchers who cannot understand "where all the squirrels come from."